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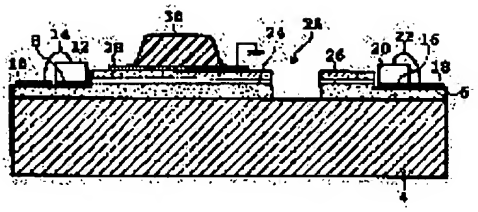
(54) OPTICAL TRANSMISSION AND RECEPTION DEVICE



(57)Abstract:
PROBLEM TO BE SOLVED: To reduce crosstalk between a light emitting element and a photodetector mounted in a hybrid state on the same substrate by providing conductive resin applied over the substrate between the light emitting element and photodetector.
SOLUTION: On the substrate 4 of Si, etc., an insulating layer 6 is formed. On a conductor pattern 8 formed on the insulating layer 6, a laser diode 12 is mounted and on the conductor pattern 16, a laser diode 20 is mounted. In the insulating layer 6, optical waveguide cores 24 and 26 are embedded. One end of the optical waveguide core 24 is coupled with the laser diode 12 and the other end is connected to an output port. One end of the optical waveguide core 26 is optically coupled with the photodiode 20 and the other end is coupled with an input port. On the insulating layer 6, an electrode 28 is formed and further grounded. The electrode 28 is coated with conductive resin 30 such as silver silicone, etc.

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CLAIMS

[Claim(s)]

[Claim 1] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern Conductive resin applied on said substrate between the 2nd wire to connect, the; aforementioned light emitting device, and said photo detector; the optical transceiver device characterized by providing the electrode of the potential regularity connected to said conductive resin, and;.

[Claim 2] The optical transceiver device according to claim 1 which possesses further the 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that an end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector.

[Claim 3] Said electrode is an optical transceiver device according to claim 2 grounded.

[Claim 4] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that the 2nd wire to connect and; end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector; Said light emitting device, the transparence insulation resin which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and; -- the conductive resin which covered said transparence insulation resin, and; -- the potential connected to said conductive resin -- the optical transceiver device characterized by providing a fixed electrode and fixed;.

[Claim 5] Said electrode is an optical transceiver device according to claim 4 grounded.

[Claim 6] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that the 2nd wire to connect and; end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector; Said photo detector, the transparence insulation resin which covered the optical coupling section of this photo detector and said 2nd optical waveguide, and said a part of 3rd and 4th conductor patterns, and; -- the conductive resin which covered said transparence insulation resin, and; -- the potential connected to said

conductive resin -- the optical transceiver device characterized by providing a fixed electrode and fixed;.
[Claim 7] Said electrode is an optical transceiver device according to claim 6 grounded.
[Claim 8] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [the] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said light emitting device, the transparence insulation resin which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and; -- the conductive resin which covered said transparence insulation resin, and; -- the potential connected to said conductive resin -- the optical transceiver device characterized by providing a fixed electrode and fixed;.
[Claim 9] It is the optical transceiver device according to claim 8 to which said substrate is a conductive substrate, said electrode is directly formed on said conductive substrate, and said conductive resin and said conductive substrate are electrically connected through said electrode.
[Claim 10] Said conductive substrate is an optical transceiver device according to claim 9 grounded.
[Claim 11] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [the] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said photo detector, the transparence insulation resin which covered the optical coupling section of this photo detector and said 2nd optical waveguide, and said a part of 3rd and 4th conductor patterns, and; -- the conductive resin which covered said transparence insulation resin, and; -- the potential connected to said conductive resin -- the optical transceiver device characterized by providing a fixed electrode and fixed;.
[Claim 12] It is the optical transceiver device according to claim 11 by which said substrate is a conductive substrate, said electrode is directly formed on this conductive substrate, and said conductive resin is electrically connected to said conductive substrate through said electrode.

[Claim 13] Said conductive substrate is an optical transceiver device according to claim 12 grounded.
[Claim 14] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [the] And so that optical coupling of the light which spreads the 2nd optical waveguide may be carried out The 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port; so that the optical coupling section of said 1st, 2nd, and 3rd optical waveguides may be covered Transparence adhesives which fix said wavelength selection filter to said substrate, and conductive resin which covered the; aforementioned wavelength selection filter; the optical transceiver device characterized by providing the electrode of the potential regularity connected to said conductive resin, and;.
[Claim 15] It is the optical transceiver device according to claim 14 by which said substrate is a conductive substrate, said electrode is directly formed on said conductive substrate, and said conductive resin is electrically connected to said conductive substrate through said electrode.
[Claim 16] Said conductive substrate is an optical transceiver device according to claim 15 grounded.
[Claim 17] It is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [the] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said light emitting device, the 1st resin of transparence insulation which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and; -- the 2nd resin of conductivity which covered said 1st resin of transparence insulation, and; -- the potential connected to said 2nd resin of conductivity -- the 1st fixed electrode and; -- said photo detector -- The optical coupling section of this photo detector and said 2nd optical waveguide And said a part of 3rd and 4th conductor patterns the 3rd covered resin of transparence insulation, and; -- the 4th resin of conductivity which covered said 3rd resin of transparence insulation, and; -- the potential connected to said 4th resin of conductivity -- the 2nd fixed electrode and; -- so that the optical coupling section between said 1st, 2nd, and 3rd optical waveguides may be included Transparence adhesives which fix said applied wavelength

selection filter to said substrate, and the 5th resin of conductivity which covered the; aforementioned wavelength selection filter; the optical transceiver device characterized by providing the 3rd electrode of the potential regularity connected to said 5th resin of conductivity, and;.

[Claim 18] It is the optical transceiver device according to claim 17 by which said substrate is a conductive substrate, said 1st, 2nd, and 3rd electrodes are directly formed on said conductive substrate, and said 2nd conductive resin, the 4th conductive resin, and the 5th conductive resin are electrically connected to said conductive substrate through said 1st, 2nd, and 3rd electrodes, respectively.

[Claim 19] Said conductive substrate is an optical transceiver device according to claim 18 grounded.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the optical transceiver device which mounted the light emitting device and the photo detector on the same substrate.

[0002] In recent years, development of the optical device towards Guanghua of a subscriber system is furthered actively. Development of the bidirectional fiber to the user system using wavelength division multiplex techniques, such as STM-PON (synchronous transfer mode-passive optical network) and ATM-PON (asynchronous transfer mode-passive optical network), is furthered, and low-pricing of an optical device including a wavelength filter has been a very important technical problem.

[0003] In order to realize such a bidirectional fiber to the user system, a compact optical device with few components is required, and the device gestalt which carried out hybrid packaging of a light emitting device, a photo detector, the wavelength filter, etc. on one substrate is expected.

[0004] In the system by which the transmitting section and a receive section are asynchronous, and operate like ATM-PON, it is required for the crosstalk to a receive section from the transmitting section in an optical module to be small enough, and this invention offers the structure which controls crosstalk between transmission and reception in the optical transceiver device with which hybrid packaging of a light emitting device and the photo detector was carried out.

[0005]

[Description of the Prior Art] In recent years, the small optical transceiver device which carried out hybrid packaging of a light emitting device, a photo detector, and the wavelength selection filter on the substrate with waveguide called a planar light wave circuit platform (PLC platform) is developed.

[0006] However, this optical transceiver device has stopped at application in the time compression multiplexing (TCM) transmission system which carried out time sharing of air time and the time of delivery. The reason has

control of the cross talk from the transmitting section to a receive section in a difficult point.
[0007] Since a light emitting device is driven in the transmitting section, the small received current not more than muA order or it flows to several 10mA current flowing in a receive section. For this reason, it is called for that the currents which flow to a receive section by crosstalk from the transmitting section are 10nA order.
[0008]
[Problem(s) to be Solved by the Invention] Since the conventional PLC module is a small module with which the transmitting section and a receive section were accumulated on the same substrate, shielding is not formed between the transmitting section and a receive section. Therefore, it was difficult to realize crosstalk small enough for the stray capacity during transmit receive wiring etc.
[0009] In order to realize the miniaturization of the optical device for ATM-PON, while carrying out hybrid packaging of a light emitting device, a photo detector, and the wavelength selection filter on the same substrate, it is required to reduce crosstalk between transmit receives.
[0010] Therefore, the purpose of this invention is offering the optical transceiver device which can reduce crosstalk between the light emitting devices and photo detectors by which hybrid packaging's was carried out on the same substrate.
[0011]
[Means for Solving the Problem] According to this invention, it is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern Conductive resin applied on said substrate between the 2nd wire to connect, the; aforementioned light emitting device, and said photo detector; the optical transceiver device characterized by providing the electrode of the potential regularity connected to said conductive resin and; is offered.
[0012] The 1st optical waveguide preferably formed so that an end might carry out optical coupling to a light emitting device, and the 2nd optical waveguide formed so that an end might carry out optical coupling to a photo detector are prepared. Preferably, the electrode is grounded.
[0013] According to other side faces of this invention, it is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that the 2nd wire to connect and; end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector; Said light emitting device, Transparence insulation resin which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and conductive resin which covered the; aforementioned transparence insulation resin; having provided the electrode of the potential regularity connected to said conductive resin, and; The optical transceiver device by which it is characterized is offered.
[0014] According to the side face of further others of this invention, it is an optical transceiver device. The

insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd optical waveguide formed on said substrate so that the 1st optical waveguide and; end which were formed on said substrate so that the 2nd wire to connect and; end might carry out optical coupling to said light emitting device might carry out optical coupling to said photo detector; Said photo detector, Transparence insulation resin which covered the optical coupling section of this photo detector and said 2nd optical waveguide, and said a part of 3rd and 4th conductor patterns, and conductive resin which covered the; aforementioned transparence insulation resin; having provided the electrode of the potential regularity connected to said conductive resin, and; The optical transceiver device by which it is characterized is offered.

[0015] According to the side face of further others of this invention, it is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said wavelength selection filter, and said wavelength selection filter; Said 1st [the] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said light emitting device, Transparence insulation resin which covered the optical coupling section of this light emitting device and said 1st optical waveguide, and said a part of 1st and 2nd conductor patterns, and conductive resin which covered the; aforementioned transparence insulation resin; having provided the electrode of the potential regularity connected to said conductive resin, and; The optical transceiver device by which it is characterized is offered.

[0016] Preferably, a substrate is a conductive substrate and the electrode is directly formed on the substrate. Conductive resin is electrically connected to the conductive substrate through the electrode. Preferably, the conductive substrate is grounded.

[0017] According to the side face of further others of this invention, it is an optical transceiver device. The insulating layer formed on the substrate and; this substrate; It adjoins mutually on said insulating layer. The 1st and 2nd formed conductor patterns; It adjoins mutually on said insulating layer. The 1st wire which connects said 2nd conductor pattern with the light emitting device and the; aforementioned light emitting device which were mounted on the 3rd and 4th formed conductor patterns and the 1st conductor pattern of; above, and the photo detector mounted on the 3rd conductor pattern of; above; said photo detector and said 4th conductor pattern The 2nd wire to connect and; The 2nd optical waveguide formed on said substrate which carries out optical coupling of the 1st optical waveguide and the; aforementioned photo detector which were formed on said substrate which carries out optical coupling of the wavelength selection filter and the; aforementioned light emitting device which were mounted in said substrate by the parenchyma top perpendicular, and said

wavelength selection filter, and said wavelength selection filter; Said 1st [the] And the 3rd optical waveguide formed on said substrate between said wavelength selection filters and optical input/output port so that optical coupling of the light which spreads the 2nd optical waveguide might be carried out; Said photo detector, Transparence insulation resin which covered the optical coupling section of this photo detector and said 3rd optical waveguide, and said a part of 3rd and 4th conductor patterns, and conductive resin which covered the; aforementioned transparence insulation resin; having provided the electrode of the potential regularity connected to said conductive resin, and; The optical transceiver device by which it is characterized is offered.
[0018]
[Embodiment of the Invention] Hereafter, many operation gestalten of this invention are explained with reference to a drawing. In explanation of each operation gestalt, the same sign is substantially attached and explained about the same component.
[0019] Reference of drawing 1 shows the sectional view of optical transceiver device 2A of the 1st operation gestalt of this invention. The insulating layer 6 is formed on the substrates 4, such as Si substrate. the case where a substrate 4 is formed from silicon -- an insulating layer 6 -- SiO2 from -- it is formed.
[0020] The conductor patterns 8 and 10 of a pair are formed in the left-hand side of an insulating layer 6, and the conductor patterns 16 and 18 of other pairs are formed in right-hand side. The laser diode 12 is mounted on the conductor pattern 8, and bonding connection of a laser diode 12 and the conductor pattern 10 is made with the golden wire 14. The photodiode 20 is mounted on the conductor pattern 16, and bonding connection of a photodiode 20 and the conductor pattern 18 is made with the golden wire 22.
[0021] Into the insulating layer 6, two optical waveguide cores 24 and 26 are laid underground. The end of the optical waveguide core 24 is arranged so that optical coupling may be carried out to a laser diode 12, and the other end is connected to the output port which is not illustrated. The end of the optical waveguide core 26 is arranged so that optical coupling may be carried out to a photodiode 20, and the other end is connected to the input port which is not illustrated.
[0022] The electrode 28 is formed on the insulating layer 6, and the electrode 28 is grounded. Conductive resin 30, such as silver silicone, is applied on the electrode 28. instead of grounding an electrode 28 -- for example, the potential of 3V and 5V grade -- you may make it connect with a fixed power source
[0023] According to this operation gestalt, since conductive resin 30 is formed between the laser diode 12 and the photodiode 20, crosstalk between a laser diode 12 and a photodiode 20 can be reduced.
[0024] Reference of drawing 2 shows the sectional view of optical transceiver device 2B of the 2nd operation gestalt of this invention. With this operation gestalt, transparence insulation resin 32, such as silicone resin, is applied to the perimeter of a laser diode 12.
[0025] Transparence insulation resin 32 has covered some of optical coupling sections of a laser diode 12 and the optical waveguide core 24, wires 14, and conductor patterns 8 and 10. This transparence insulation resin 32 has the role which prevents the short circuit of the conductor patterns 8 and 10 by the conductive resin applied later while securing the optical path to the optical waveguide core 24.
[0026] Conductive resin 34, such as silver silicone, is applied on transparence insulation resin 32. Conductive resin 34 is connected to the grounded electrode 36. Instead of grounding an electrode 36, you may make it connect with the power source of potential regularity.
[0027] According to this operation gestalt, since the laser diode 12 is covered with transparence insulation resin 32 and conductive resin 34, the crosstalk to other passive circuit elements of photodiode 20 grade from a laser diode 12 can be reduced.

[0028] Reference of drawing 3 shows the sectional view of optical transceiver device 2C of the 3rd operation gestalt of this invention. With this operation gestalt, transparence insulation resin 38, such as silicone resin, is applied to the perimeter of a photodiode 20. Transparence insulation resin 38 has covered some of optical coupling sections of a photodiode 20 and the optical waveguide core 26, wires 22, and conductor patterns 16 and 18.

[0029] Conductive resin 40, such as silver silicone, is applied on transparence insulation resin 38. Conductive resin 40 is connected to the grounded electrode 42. Instead of grounding an electrode 42, you may make it connect with the power source of potential regularity.

[0030] Transparence insulation resin 38 has the role which prevents the short circuit of the conductor patterns 16 and 18 by the applied conductive resin 40 while securing the optical path from the waveguide core 26 to a photodiode 20.

[0031] According to this operation gestalt, the effectiveness which it not only can intercept effectively the crosstalk to a photodiode 20 from a laser diode 12, but intercepts external noises, such as IC for a drive prepared outside, is expectable.

[0032] Reference of drawing 4 shows the sectional view of optical transceiver device 2D of the 4th operation gestalt of this invention. Drawing 5 shows the top view of the 4th operation gestalt. With this operation gestalt, while the perimeter of a laser diode 12 is covered by transparence insulation resin 32, such as silicone resin, transparence insulation resin 32 is covered with conductive resin 34, such as silver silicone.

[0033] Moreover, the perimeter of a photodiode 20 is also covered by transparence insulation resin 38, such as silicone resin, and transparence insulation resin 38 is covered with conductive resin 40, such as silver silicone.

[0034] Furthermore, in this operation gestalt, the slot 46 is formed in the Si substrate 4, the wavelength selection filter 48 is inserted all over this slot 46, and it is fixed with the transparence adhesives 50. As shown in drawing 5 , on the Si substrate 4, the 2nd optical waveguide core 56 which carries out optical coupling of the 1st optical waveguide core 54 which carries out optical coupling of a laser diode 12 and the wavelength selection filter 48, and a photodiode 20 and the wavelength selection filter 48 is formed.

[0035] The 3rd optical waveguide core 58 is formed between the wavelength selection filter 48 and optical input/output port 59 so that optical coupling of the light which spreads the 1st and 2nd optical waveguide cores 54 and 56 may be further carried out on the Si substrate 4.

[0036] The perimeter of the wavelength selection filter 48 is covered with conductive resin 52, such as silver silicone. On the Si substrate 4, the substrate contact electrodes 64, 66, 68, and 70 are formed directly.

[0037] The rear-face electrode 72 is formed in the rear face of the Si substrate 4. The rear-face electrode 72 is grounded. Instead of grounding the rear-face electrode 72, you may make it connect with the power source of potential regularity.

[0038] Since the Si substrate 4 is conductivity, conductive resin 34 is grounded through the substrate contact electrode 64, the Si substrate 4, and the rear-face electrode 72. Similarly, conductive resin 40 is grounded through the substrate contact electrode 66, the Si substrate 4, and the rear-face electrode 72. Furthermore, conductive resin 52 is grounded through the substrate contact electrodes 68 and 70, the Si substrate 4, and the rear-face electrode 72.

[0039] According to this operation gestalt, a laser diode 12 is covered with conductive resin 34 through transparence insulation resin 32, and the photodiode 20 is covered with conductive resin 40 through transparence insulation resin 38. Furthermore, conductive resin 52 is formed between the laser diode 12 and the photodiode 20.

[0040] Therefore, while being able to intercept thru/or reduce effectively crosstalk between a laser diode 12 and a photodiode 20, external noises, such as IC for a drive prepared outside, can also be intercepted or reduced effectively. Consequently, implementation of the optical transceiver device which can be operated [that it is small and] asynchronously is possible.

[0041] Hereafter, with reference to a drawing, the manufacture process of optical transceiver device 2D of the 4th operation gestalt is explained. First, as shown in drawing 6 (A), it is SiO2 [with a thickness of about 1 micrometer] on the Si (100) substrate 74. The film 76 is formed by thermal oxidation etc.

[0042] Subsequently, SiO2 other than the field which carries out patterning by the photolithography and forms a terrace 78 The film (oxide film) 76 is removed. It dips in a KOH solution and is SiO2. The field which removed the film 76 is etched. The depth of this etching is made into thickness about extent of the undershirt clad of waveguide, i.e., about 20 micrometers.

[0043] Subsequently, SiO2 from which only the depth etched by the flame depositing method etc. serves as the 1st undershirt clad 80 as shown in drawing 6 (B) It deposits all over a substrate. Subsequently, flattening is ground and carried out until the top face of a terrace 78 is exposed, as shown in drawing 6 (C).

[0044] SiO2 which serves as the 2nd undershirt clad 82 as shown in drawing 7 (D) Only the thickness called for by the bottom formula is deposited all over a substrate 74.

Deposition thickness =(conductor pattern thickness) +(pewter thickness)+ (barrier layer height of a laser diode) This deposition thickness is about 20 micrometers. Subsequently, the core layer 84 which doped the impurity to which the refractive index of germanium (germanium) etc. is made to increase is deposited, patterning of the unnecessary fields other than the guided wave section is carried out by the photolithography, they are removed, and a waveguide core is formed. Subsequently, the thickness SiO2 comparable as the undershirt clads 80 and 82 is deposited all over a substrate, and the exaggerated clad 86 is formed.

[0045] Subsequently, as shown in drawing 7 (E), the field containing the light corpuscle child loading section and the conductor pattern formation section is etched by reactive ion etching (RIE), and the waveguide end faces 90 and 92 are formed. The depth to etch is carried out until the top face of a terrace 78 is exposed exactly.

[0046] Similarly, it etches by RIE, holes 91, 93, 95, and 97 are formed, and the Si substrate 74 and the substrate contact electrodes 64, 66, 68, and 70 which take a flow are formed all over these holes. 88 is a resist.

[0047] Subsequently, as shown in drawing 8 and drawing 9 , it is about 0.5-micrometer thin SiO2 on a terrace 78 by thermal oxidation. An insulator layer 6 is formed. Furthermore, the slot 94 which crosses the point that the waveguide cores 54, 56, and 58 join using a dicing saw is formed.

[0048] Subsequently, the sequential vacuum evaporationo of Ti, nickel, and the Au is carried out all over a substrate, and a resist is applied further. It etches by leaving the part of conductor patterns 6, 8, 16, and 18, and a photolithography technique removing a resist.

[0049] Etching may be performed by RIE and a substrate may be dipped in etchant. The etchant of a nitric-acid system is used to Ti and nickel, and golden etchant is used for Au. As an alternative, it is possible to also form conductor patterns 6, 8, 16, and 18 by the lift-off method. Similarly, the rear-face electrode 72 is formed in the rear face of a substrate 74.

[0050] Subsequently, polyimide resin is applied to the whole substrate top face by the spinner, and a resist is applied further. Patterning of the resist is carried out with a photolithography technique, and it is further immersed in a solvent, and polyimide resin is removed so that the light corpuscle child loading section, the pad section for wirebonding, and a waveguide end face may be exposed at least.

[0051] this shows drawing 10 -- as -- a conductor -- a part of patterning 8 and 10 covers by the polyimide

insulating layer 96 -- having -- a conductor -- a part of patterning 16 and 18 is covered by the polyimide insulating layer 98. Subsequently, a dicing saw cuts the Si substrate 74 to each PLC platform.

[0052] Subsequently, as shown in drawing 11 , a laser diode 12 and a photodiode 20 are mounted in a position by bonding. this bonding -- the light corpuscle child 12 side and 20 sides -- a pewter bump -- forming -- you may carry out -- a PLC platform side -- pewter bump ****** -- it is good even if like.

[0053] Bonding connection of a laser diode 12 and the conductor pattern 10 is made with the golden wire 14 after mounting of a laser diode 12 and a photodiode 20, and bonding connection of a photodiode 20 and the conductor pattern 18 is made with the golden wire 22. Furthermore, the wavelength selection filter 48 is inserted all over a slot 94, and the wavelength selection filter 48 is fixed to the PLC platform (substrate) 4 with the transparent adhesives 50.

[0054] Subsequently, as shown in drawing 4 and drawing 5 , potting of the transparence insulation resin 32 and 38, such as silicone resin, is carried out to the perimeter of a laser diode 12 and a photodiode 20, and it carries out a cure to it.

[0055] Silicone resin with the high viscosity which mixed fillers, such as a silica, in the perimeter of a laser diode 12 and a photodiode 20 depending on the need is applied in the shape of a dam, transparent silicone resin flows, and it is good also as a stop.

[0056] Furthermore, the outside of transparence insulation resin 32 and 38 and the perimeter of the wavelength selection filter 48 are covered with conductive resin 34, 40, and 52, such as silver silicone resin. It is made for conductive resin 34, 40, and 52 to contact the substrate contact electrodes 64, 66, 68, and 70 at this time. The cure of the conductive resin 34, 40, and 52 is carried out to the last.

[0057] Thus, optical transceiver device 2D of the formed 4th operation gestalt is shown in drawing 4 and drawing 5 . Furthermore, although not illustrated especially, packaging of the optical transceiver device 2D is carried out by plastics mold etc.

[0058]

[Effect of the Invention] As explained above, according to this invention, the optical transceiver device which can reduce crosstalk between the light emitting device by which hybrid packaging was carried out on the same substrate, and a photo detector can be offered. Furthermore, offer of a compact and the optical transceiver device which can be operated asynchronously is attained, and it can contribute to the spread of optical subscriber systems.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

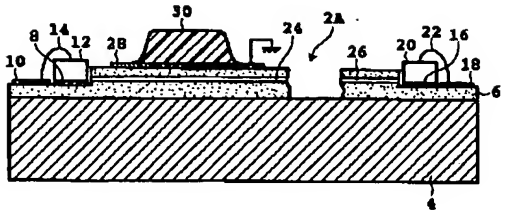
[Drawing 1] It is the sectional view of the 1st operation gestalt of this invention.

[Drawing 2] It is the sectional view of the 2nd operation gestalt of this invention.
[Drawing 3] It is the sectional view of the 3rd operation gestalt of this invention.
[Drawing 4] It is the sectional view of the 4th operation gestalt of this invention.
[Drawing 5] It is the top view of the 4th operation gestalt.
[Drawing 6] It is drawing showing a manufacture process.
[Drawing 7] It is drawing showing a manufacture process.
[Drawing 8] It is drawing showing a manufacture process.
[Drawing 9] It is drawing showing a manufacture process.
[Drawing 10] It is drawing showing a manufacture process.
[Drawing 11] It is drawing showing a manufacture process.
[Description of Notations]
4 Substrate
8, 10, 16, 18 Conductor pattern
12 Light Emitting Device
20 Photo Detector
24 26 Optical waveguide
28, 36, 42 Electrode
30, 34, 40, 52 Conductive resin
32 38 Transparence insulation resin
64, 66, 68, 70 Substrate contact electrode

DRAWINGS

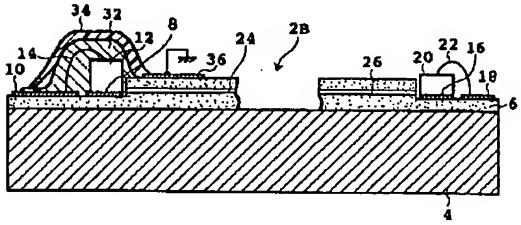
[Drawing 1]

第１実施形態



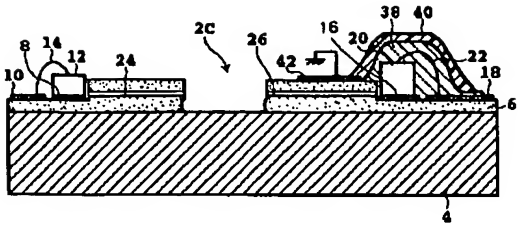
[Drawing 2]

第２実施形態



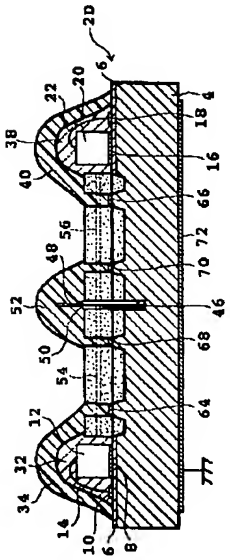
[Drawing 3]

第３実施形態



[Drawing 4]

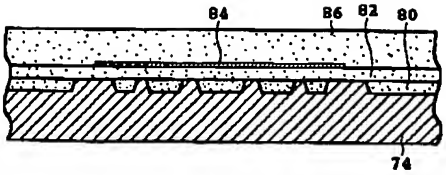
第４実施形態



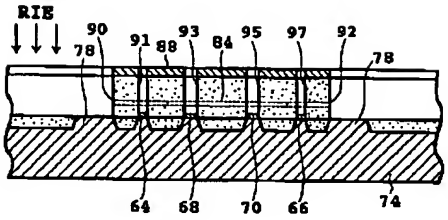
[Drawing 7]

製造プロセス図

(D)

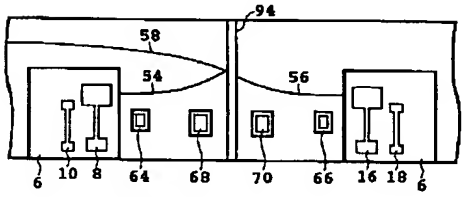


(E)



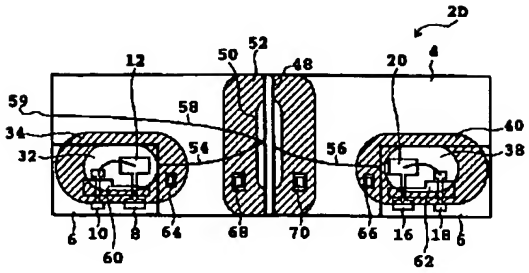
[Drawing 8]

製造プロセス図



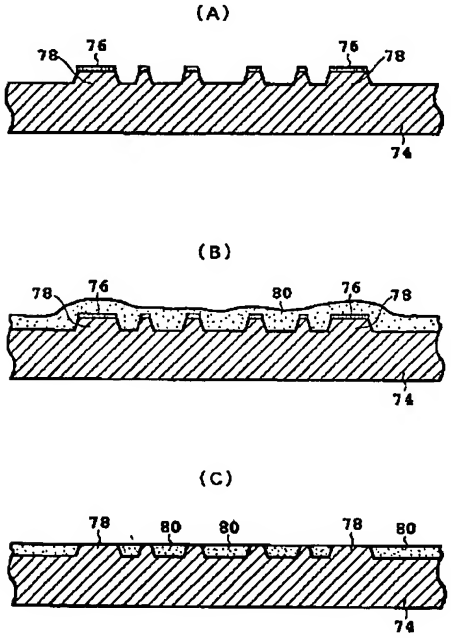
[Drawing 5]

第４実施形態平面図



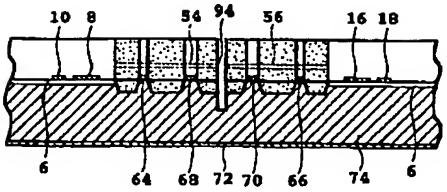
[Drawing 6]

製造プロセス図



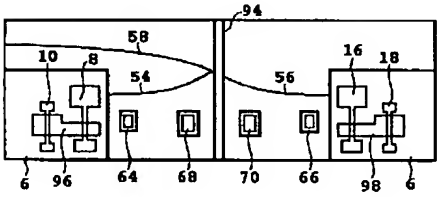
[Drawing 9]

製造プロセス図



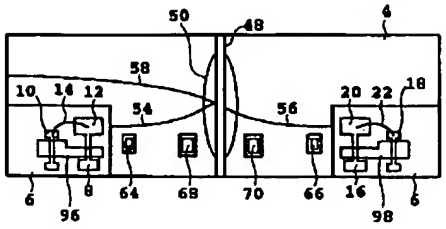
[Drawing 10]

製造プロセス図



[Drawing 11]

製造プロセス図



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Ｈ０１Ｓ　3/18		Ｈ０１Ｌ	31/02	Ｃ
Ｈ０４Ｂ　10/02		Ｈ０４Ｂ	9/00	Ｍ

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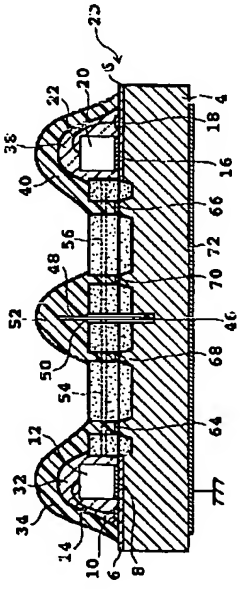
(54)【発明の名称】　光送受信デバイス

(57)【要約】

【課題】　本発明の課題は、同一基板上にハイブリッド実装された発光素子と受光素子の間の漏話を低減可能な光送受信デバイスを提供することである。

【解決手段】　光送受信デバイスであって、基板上に発光素子と受光素子がハイブリッド実装されている。発光素子と受光素子の間の基板上には導電性樹脂が塗布されており、この導電性樹脂は電位一定の電極に接続されている。発光素子と受光素子の間に導電性樹脂を設けたことにより、発光素子と受光素子の間の漏話を低減することができる。この構成に代えて、発光素子又は受光素子を導電性樹脂で覆うようにしてもよい。この場合には、発光素子と光導波路との光結合部及び受光素子と光導波路との光結合部をまず透明絶縁性樹脂で覆ってから、その上に導電性樹脂を適用する。

第４実施形態



【特許請求の範囲】

【請求項１】　光送受信デバイスであって、
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；前記発光素子と前記受光素子の間の前記基板上に塗布された導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項２】　一端が前記発光素子に光結合するように前記基板上に形成された第１光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第２光導波路とを更に具備した請求項１記載の光送受信デバイス。

【請求項３】　前記電極は接地されている請求項２記載の光送受信デバイス。

【請求項４】　光送受信デバイスであって、
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；一端が前記発光素子に光結合するように前記基板上に形成された第１光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第２光導波路と；前記発光素子、該発光素子と前記第１光導波路の光結合部及び前記第１及び第２導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項５】　前記電極は接地されている請求項４記載の光送受信デバイス。

【請求項６】　光送受信デバイスであって、
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；一端が前記発光素子に光結合するように前記基板上に形成された第１光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第２光導波路と；前記受光素子、該受光素子と前記第２光導波路の光結合部及び前記第３及び第４導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項７】　前記電極は接地されている請求項６記載の光送受信デバイス。

【請求項８】　光送受信デバイスであって、
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第１光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第２光導波路と；前記第１及び第２光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第３光導波路と；前記発光素子、該発光素子と前記第１光導波路の光結合部及び前記第１及び第２導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項９】　前記基板は導電性基板であり、前記電極は前記導電性基板上に直接形成されており、前記導電性樹脂と前記導電性基板とは前記電極を介して電気的に接続されている請求項８記載の光送受信デバイス。

【請求項１０】　前記導電性基板は接地されている請求項９記載の光送受信デバイス。

【請求項１１】　光送受信デバイスであって、
基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第１光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第２光導波路と；前記第１及び第２光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの

間の前記基板上に形成された第３光導波路と；前記受光素子、該受光素子と前記第２光導波路の光結合部及び前記第３及び第４導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項１２】　前記基板は導電性基板であり、前記電極は該導電性基板上に直接形成されており、前記導電性樹脂は前記電極を介して前記導電性基板に電気的に接続されている請求項１１記載の光送受信デバイス。

【請求項１３】　前記導電性基板は接地されている請求項１２記載の光送受信デバイス。

【請求項１４】　光送受信デバイスであって、

基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第１光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第２光導波路と；前記第１及び第２光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第３光導波路と；前記第１、第２及び第３光導波路の光結合部を覆うように前記波長選択フィルタを前記基板に固定する透明接着剤と；前記波長選択フィルタを覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイス。

【請求項１５】　前記基板は導電性基板であり、前記電極は前記導電性基板上に直接形成されており、前記導電性樹脂は前記電極を介して前記導電性基板に電気的に接続されている請求項１４記載の光送受信デバイス。

【請求項１６】　前記導電性基板は接地されている請求項１５記載の光送受信デバイス。

【請求項１７】　光送受信デバイスであって、

基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第１光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第２光導波路と；前記第１及び第２光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第３光導波路と；前記発光素子、該発光素子と前記第１光導波路の光結合部及び前記第１及び第２導体パターンの一部を覆った透明絶縁性第１樹脂と；前記透明絶縁性第１樹脂を覆った導電性第２樹脂と；前記導電性第２樹脂に接続された電位一定の第１電極と；前記受光素子、該受光素子と前記第２光導波路の光結合部及び前記第３及び第４導体パターンの一部を覆った透明絶縁性第３樹脂と；前記透明絶縁性第３樹脂を覆った導電性第４樹脂と；前記導電性第４樹脂に接続された電位一定の第２電極と；前記第１、第２及び第３光導波路間の光結合部を含むように適用された前記波長選択フィルタを前記基板に固定する透明接着剤と；前記波長選択フィルタを覆った導電性第５樹脂と；前記導電性第５樹脂に接続された電位一定の第３電極と；を具備したことを特徴とする光送受信デバイス。

【請求項１８】　前記基板は導電性基板であり、前記第１、第２及び第３電極は前記導電性基板上に直接形成されており、前記第２導電性樹脂、第４導電性樹脂及び第５導電性樹脂はそれぞれ前記第１、第２及び第３電極を介して前記導電性基板に電気的に接続されている請求項１７記載の光送受信デバイス。

【請求項１９】　前記導電性基板は接地されている請求項１８記載の光送受信デバイス。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は同一基板上に発光素子と受光素子とを実装した光送受信デバイスに関する。

【０００２】近年、加入者系の光化に向けた光デバイスの開発が活発に進められている。ＳＴＭ－ＰＯＮ（シンクロナス・トランスファー・モード－パッシブ・オプティカル・ネットワーク）及びＡＴＭ－ＰＯＮ（アシンクロナス・トランスファー・モード－パッシブ・オプティカル・ネットワーク）などの波長分割多重技術を用いた双方向光加入者系システムの開発が進められており、波長フィルタを含めた光デバイスの低価格化が極めて重要な課題となっている。

【０００３】このような双方向光加入者系システムを実現するためには、部品数の少ないコンパクトな光デバイスが必要であり、発光素子、受光素子及び波長フィルタ等を１つの基板上にハイブリッド実装したデバイス形態が期待されている。

【０００４】ＡＴＭ－ＰＯＮのように送信部と受信部が非同期で動作するシステムでは、光モジュール内の送信部から受信部への漏話が十分小さいことが必要であり、本発明は発光素子及び受光素子がハイブリッド実装された光送受信デバイスにおいて、送信及び受信間の漏話を

抑制する構造を提供するものである。

【０００５】

【従来の技術】近年、プレーナ・ライトウェイブ・サーキット・プラットフォーム（ＰＬＣプラットフォーム）と呼ばれる導波路付基板上に発光素子、受光素子及び波長選択フィルタをハイブリッド実装した小型の光送受信デバイスが開発されている。

【０００６】しかし、この光送受信デバイスは送信時間と受信時間とを時分割したタイム・コンプレッション・マルチプレキシング（ＴＣＭ）伝送系への適用に止まっている。その理由は、送信部から受信部へのクロストークの抑制が困難な点にある。

【０００７】送信部では発光素子を駆動するために数１０ｍＡの電流が流れるのに対し、受信部ではμＡオーダーかそれ以下の小さな受信電流が流れる。このため、送信部からの漏話によって受信部に流れる電流は１０ｎＡオーダーであることが求められる。

【０００８】

【発明が解決しようとする課題】従来のＰＬＣモジュールは同一基板上に送信部及び受信部が集積された小型なモジュールであるため、送信部と受信部の間にシールドが形成されていない。故に、送信受信配線間の浮遊容量等のために十分に小さな漏話を実現することが困難であった。

【０００９】ＡＴＭ－ＰＯＮ向けの光デバイスの小型化を実現するためには、発光素子、受光素子及び波長選択フィルタを同一基板上にハイブリッド実装すると共に、送信受信間の漏話を低減することが必要である。

【００１０】よって、本発明の目的は、同一基板上にハイブリッド実装された発光素子と受光素子の間の漏話を低減することが可能な光送受信デバイスを提供することである。

【００１１】

【課題を解決するための手段】本発明によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；前記発光素子と前記受光素子の間の前記基板上に塗布された導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【００１２】好ましくは、一端が発光素子に光結合するように形成された第１光導波路と、一端が受光素子に光結合するように形成された第２光導波路が設けられている。好ましくは、電極は接地されている。

【００１３】本発明の他の側面によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；一端が前記発光素子に光結合するように前記基板上に形成された第１光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第２光導波路と；前記発光素子、該発光素子と前記第１光導波路の光結合部及び前記第１及び第２導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【００１４】本発明の更に他の側面によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；一端が前記発光素子に光結合するように前記基板上に形成された第１光導波路と；一端が前記受光素子に光結合するように前記基板上に形成された第２光導波路と；前記受光素子、該受光素子と前記第２光導波路の光結合部及び前記第３及び第４導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【００１５】本発明の更に他の側面によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第１光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第２光導波路と；前記第１及び第２光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第３光導

波路と；前記発光素子、該発光素子と前記第１光導波路の光結合部及び前記第１及び第２導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【００１６】好ましくは、基板は導電性基板であり、基板上に電極が直接形成されている。導電性樹脂は電極を介して導電性基板に電気的に接続されている。好ましくは、導電性基板は接地されている。

【００１７】本発明の更に他の側面によると、光送受信デバイスであって、基板と；該基板上に形成された絶縁層と；前記絶縁層上に互いに隣接して形成された第１及び第２導体パターンと；前記絶縁層上に互いに隣接して形成された第３及び第４導体パターンと；前記第１導体パターン上に実装された発光素子と；前記発光素子と前記第２導体パターンを接続する第１ワイヤと；前記第３導体パターン上に実装された受光素子と；前記受光素子と前記第４導体パターンを接続する第２ワイヤと；前記基板に実質上垂直に実装された波長選択フィルタと；前記発光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第１光導波路と；前記受光素子と前記波長選択フィルタとを光結合する前記基板上に形成された第２光導波路と；前記第１及び第２光導波路を伝搬する光を光結合するように、前記波長選択フィルタと光入出力ポートとの間の前記基板上に形成された第３光導波路と；前記受光素子、該受光素子と前記第３光導波路の光結合部及び前記第３及び第４導体パターンの一部を覆った透明絶縁性樹脂と；前記透明絶縁性樹脂を覆った導電性樹脂と；前記導電性樹脂に接続された電位一定の電極と；を具備したことを特徴とする光送受信デバイスが提供される。

【００１８】

【発明の実施の形態】以下、図面を参照して本発明の数多くの実施形態について説明する。各実施形態の説明において、実質的に同一構成部分については同一符号を付して説明する。

【００１９】図１を参照すると、本発明第１実施形態の光送受信デバイス２Ａの断面図が示されている。Ｓｉ基板等の基板４上には絶縁層６が形成されている。基板４がシリコンから形成される場合には、絶縁層６はSiO_2から形成される。

【００２０】絶縁層６の左側には一対の導体パターン８，１０が形成されており、右側には他の一対の導体パターン１６，１８が形成されている。導体パターン８上にはレーザダイオード１２が実装されており、レーザダイオード１２と導体パターン１０とは金ワイヤ１４でボンディング接続されている。導体パターン１６上にはフォトダイオード２０が実装されており、フォトダイオード２０と導体パターン１８とは金ワイヤ２２でボンディング接続されている。

【００２１】絶縁層６中には２本の光導波路コア２４，２６が埋設されている。光導波路コア２４の一端はレーザダイオード１２に光結合するように配置されており、他端は図示しない出力ポートに接続されている。光導波路コア２６の一端はフォトダイオード２０に光結合するように配置されており、他端は図示しない入力ポートに接続されている。

【００２２】絶縁層６上には電極２８が形成されており、電極２８は接地されている。電極２８上には銀シリコーン等の導電性樹脂３０が塗布されている。電極２８を接地する代わりに、例えば３Ｖ，５Ｖ等の電位一定な電源に接続するようにしてもよい。

【００２３】本実施形態によれば、レーザダイオード１２とフォトダイオード２０の間に導電性樹脂３０が設けられているので、レーザダイオード１２とフォトダイオード２０との間の漏話を低減することができる。

【００２４】図２を参照すると、本発明第２実施形態の光送受信デバイス２Ｂの断面図が示されている。本実施形態ではレーザダイオード１２の周囲にシリコーン樹脂等の透明絶縁性樹脂３２が塗布されている。

【００２５】透明絶縁性樹脂３２はレーザダイオード１２と光導波路コア２４との光結合部、ワイヤ１４及び導体パターン８，１０の一部を覆っている。この透明絶縁性樹脂３２は光導波路コア２４への光路を確保すると共に、後で適用される導電性樹脂による導体パターン８，１０の短絡を防止する役割を有している。

【００２６】透明絶縁性樹脂３２上には銀シリコーン等の導電性樹脂３４が塗布されている。導電性樹脂３４は接地された電極３６に接続されている。電極３６を接地する代わりに、電位一定の電源に接続するようにしてもよい。

【００２７】本実施形態によれば、レーザダイオード１２が透明絶縁性樹脂３２及び導電性樹脂３４で覆われているため、レーザダイオード１２からフォトダイオード２０等の他の回路部品への漏話を低減することができる。

【００２８】図３を参照すると、本発明第３実施形態の光送受信デバイス２Ｃの断面図が示されている。本実施形態では、フォトダイオード２０の周囲にシリコーン樹脂等の透明絶縁性樹脂３８が塗布されている。透明絶縁性樹脂３８はフォトダイオード２０と光導波路コア２６との光結合部、ワイヤ２２及び導体パターン１６，１８の一部を覆っている。

【００２９】透明絶縁性樹脂３８上には銀シリコーン等の導電性樹脂４０が塗布されている。導電性樹脂４０は接地された電極４２に接続されている。電極４２を接地する代わりに、電位一定の電源に接続するようにしてもよい。

【００３０】透明絶縁性樹脂３８は導波路コア２６から

フォトダイオード２０への光路を確保すると共に、塗布された導電性樹脂４０による導体パターン１６，１８の短絡を防止する役割を有している。

【００３１】本実施形態によれば、レーザダイオード１２からフォトダイオード２０への漏話を有効に遮断できるばかりでなく、外部に設けられた駆動用ＩＣなどの外来雑音をも遮断する効果を期待できる。

【００３２】図４を参照すると、本発明第４実施形態の光送受信デバイス２Ｄの断面図が示されている。図５は第４実施形態の平面図を示している。本実施形態では、レーザダイオード１２の周囲がシリコーン樹脂等の透明絶縁性樹脂３２で覆われていると共に、透明絶縁性樹脂３２が銀シリコーン等の導電性樹脂３４で覆われている。

【００３３】また、フォトダイオード２０の周囲もシリコーン樹脂等の透明絶縁性樹脂３８で覆われており、透明絶縁性樹脂３８は銀シリコーン等の導電性樹脂４０で覆われている。

【００３４】更に、本実施形態では、Ｓｉ基板４に溝４６が形成されており、この溝４６中に波長選択フィルタ４８が挿入され、透明接着剤５０で固定されている。図５に示されるように、Ｓｉ基板４上にはレーザダイオード１２と波長選択フィルタ４８とを光結合する第１光導波路コア５４と、フォトダイオード２０と波長選択フィルタ４８とを光結合する第２光導波路コア５６が形成されている。

【００３５】Ｓｉ基板４上には更に、第１及び第２光導波路コア５４，５６を伝搬する光を光結合するように、波長選択フィルタ４８と光入出力ポート５９との間に第３光導波路コア５８が形成されている。

【００３６】波長選択フィルタ４８の周囲は銀シリコーン等の導電性樹脂５２で覆われている。Ｓｉ基板４上には基板コンタクト電極６４，６６，６８，７０が直接形成されている。

【００３７】Ｓｉ基板４の裏面には裏面電極７２が形成されている。裏面電極７２は接地されている。裏面電極７２を接地する代わりに、電位一定の電源に接続するようにしてもよい。

【００３８】Ｓｉ基板４は導電性であるから、導電性樹脂３４は基板コンタクト電極６４、Ｓｉ基板４、裏面電極７２を介して接地される。同様に、導電性樹脂４０は基板コンタクト電極６６、Ｓｉ基板４及び裏面電極７２を介して接地される。更に、導電性樹脂５２は基板コンタクト電極６８，７０，Ｓｉ基板４及び裏面電極７２を介して接地される。

【００３９】本実施形態によれば、レーザダイオード１２が透明絶縁性樹脂３２を介して導電性樹脂３４で覆われ、フォトダイオード２０が透明絶縁性樹脂３８を介して導電性樹脂４０で覆われている。更に、レーザダイオード１２とフォトダイオード２０の間に導電性樹脂５２が設けられている。

【００４０】よって、レーザダイオード１２とフォトダイオード２０との間の漏話を有効に遮断乃至低減できると共に、外部に設けられた駆動用ＩＣ等の外来雑音をも有効に遮断又は低減することができる。その結果、小型で非同期動作可能な光送受信デバイスの実現が可能である。

【００４１】以下、図面を参照して第４実施形態の光送受信デバイス２Ｄの製造プロセスを説明する。まず、図６（Ａ）に示すように、Ｓｉ（１００）基板７４上に約１μｍ程度の厚さのSiO_2 膜７６を例えば熱酸化等により形成する。

【００４２】次いで、フォトリソグラフィでパターニングして、テラス７８を形成する領域以外のSiO_2 膜（酸化膜）７６を除去する。ＫＯＨ溶液に浸し、SiO_2 膜７６を除去した領域をエッチングする。このエッチングの深さは導波路のアンダークラッドの厚さ程度、即ち約２０μｍ程度とする。

【００４３】次いで、図６（Ｂ）に示すように、火炎堆積法等によりエッチングした深さだけ第１のアンダークラッド８０となるSiO_2 を基板全面に堆積する。次いで、図６（Ｃ）に示すように、テラス７８の上面が露出するまで研磨し、平坦化する。

【００４４】図７（Ｄ）に示すように、第２のアンダークラッド８２となるSiO_2 を下式で求められる厚さだけ基板７４の全面に堆積する。

堆積厚さ＝（導体パターン厚）＋（ハンダ厚）＋（レーザダイオードの活性層高さ）

この堆積厚さは約２０μｍ程度である。次いで、ゲルマニウム（Ｇｅ）等の屈折率を増加させる不純物をドープしたコア層８４を堆積し、導波部以外の不要な領域をフォトリソグラフィによりパターニングして除去して、導波路コアを形成する。次いで、基板全面にアンダークラッド８０，８２と同程度の厚さSiO_2を堆積し、オーバークラッド８６を形成する。

【００４５】次いで、図７（Ｅ）に示すように、光素子搭載部及び導体パターン形成部を含む領域をリアクティブ・イオン・エッチング（ＲＩＥ）でエッチングし、導波路端面９０，９２を形成する。エッチングする深さはテラス７８の上面が丁度露出するまでとする。

【００４６】同様に、ＲＩＥでエッチングして、穴９１，９３，９５，９７を形成し、これらの穴中にＳｉ基板７４と導通をとる基板コンタクト電極６４，６６，６８，７０を形成する。８８はレジストである。

【００４７】次いで、図８及び図９に示すように、熱酸化によりテラス７８上に約０．５μｍ程度の薄いSiO_2 絶縁膜６を形成する。更に、ダイシングソーを使用して導波路コア５４，５６，５８が合流する点を横断する溝９４を形成する。

【００４８】次いで、基板全面にＴｉ，Ｎｉ，Ａｕを順

次蒸着し、更にレジストを塗布する。導体パターン６，８，１６，１８の部分を残してフォトリソグラフィ技術によりレジストを除去し、エッチングをする。

【００４９】エッチングはＲＩＥで行ってもよいし、基板をエッチャントに浸してもよい。Ｔｉ及びＮｉに対しては硝酸系のエッチャントを使用し、Ａｕには金エッチャントを使用する。代替案として、リフトオフ法により導体パターン６，８，１６，１８も形成することが可能である。同様にして、基板７４の裏面に裏面電極７２を形成する。

【００５０】次いで、基板上面全体に例えばポリイミド樹脂をスピナーで塗布し、更にレジストを塗布する。レジストをフォトリソグラフィ技術によりパターニングして、更に溶剤に浸漬し、少なくとも光素子搭載部、ワイヤボンディング用のパッド部、導波路端面が露出するようにポリイミド樹脂を除去する。

【００５１】これにより、図１０に示すように導体パターニング８，１０の一部がポリイミド絶縁層９６で覆われ、導体パターニング１６，１８の一部がポリイミド絶縁層９８で覆われる。次いで、ダイシングソーによりＳｉ基板７４を各ＰＬＣプラットフォームに切断する。

【００５２】次いで、図１１に示すようにレーザダイオード１２及びフォトダイオード２０を所定の位置にボンディングにより実装する。このボンディングは光素子１２，２０側にハンダバンプを形成して行ってもよいし、ＰＬＣプラットフォーム側にハンダバンプ設けるようにしてもよい。

【００５３】レーザダイオード１２及びフォトダイオード２０の実装後、レーザダイオード１２と導体パターン１０とを金ワイヤ１４でボンディング接続し、フォトダイオード２０と導体パターン１８とを金ワイヤ２２でボンディング接続する。更に、波長選択フィルタ４８を溝９４中に挿入し、透明な接着剤５０で波長選択フィルタ４８をＰＬＣプラットフォーム（基板）４に固定する。

【００５４】次いで、図４及び図５に示すように、レーザダイオード１２及びフォトダイオード２０の周囲にシリコーン樹脂等の透明絶縁性樹脂３２，３８をポッティングし、キュアする。

【００５５】必要によっては、レーザダイオード１２及びフォトダイオード２０の周囲にシリカ等のフィラを混入した粘度の高いシリコーン樹脂をダム状に塗布して、透明なシリコーン樹脂の流れ止めとしてもよい。

【００５６】更に、透明絶縁性樹脂３２，３８の外側及び波長選択フィルタ４８の周囲を銀シリコーン樹脂等の導電性樹脂３４，４０，５２で覆う。このとき、導電性樹脂３４，４０，５２が基板コンタクト電極６４，６６，６８及び７０に接触するようにする。最後に導電性樹脂３４，４０，５２をキュアする。

【００５７】このようにして形成した第４実施形態の光送受信デバイス２Ｄが図４及び図５に示されている。更に、特に図示しないが光送受信デバイス２Ｄをプラスチックモールド等によりパッケージングする。

【００５８】

【発明の効果】以上説明したように、本発明によれば、同一基板上にハイブリッド実装された発光素子と受光素子間の漏話を低減することのできる光送受信デバイスを提供することができる。更に、コンパクト且つ非同期動作が可能な光送受信デバイスの提供が可能となり、光加入者系の普及に寄与することができる。

【図面の簡単な説明】

【図１】本発明第１実施形態の断面図である。

【図２】本発明第２実施形態の断面図である。

【図３】本発明第３実施形態の断面図である。

【図４】本発明第４実施形態の断面図である。

【図５】第４実施形態の平面図である。

【図６】製造プロセスを示す図である。

【図７】製造プロセスを示す図である。

【図８】製造プロセスを示す図である。

【図９】製造プロセスを示す図である。

【図１０】製造プロセスを示す図である。

【図１１】製造プロセスを示す図である。

【符号の説明】

４　基板

８，１０，１６，１８　導体パターン

１２　発光素子

２０　受光素子

２４，２６　光導波路

２８，３６，４２　電極

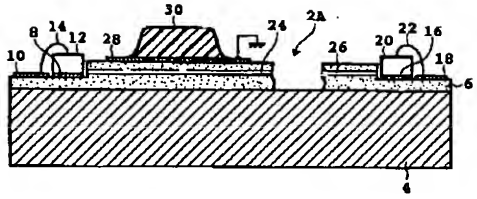
３０，３４，４０，５２　導電性樹脂

３２，３８　透明絶縁性樹脂

６４，６６，６８，７０　基板コンタクト電極

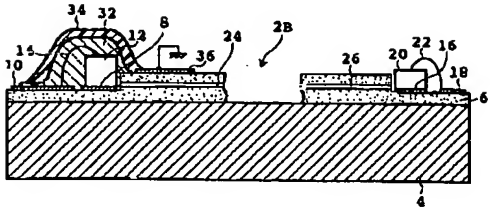
【図１】

第１実施形態



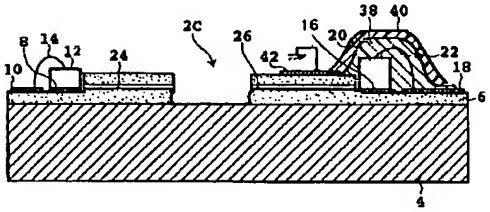
【図２】

第２実施形態



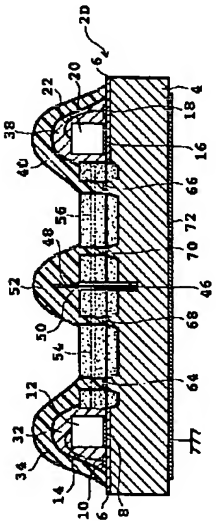
【図３】

第３実施形態



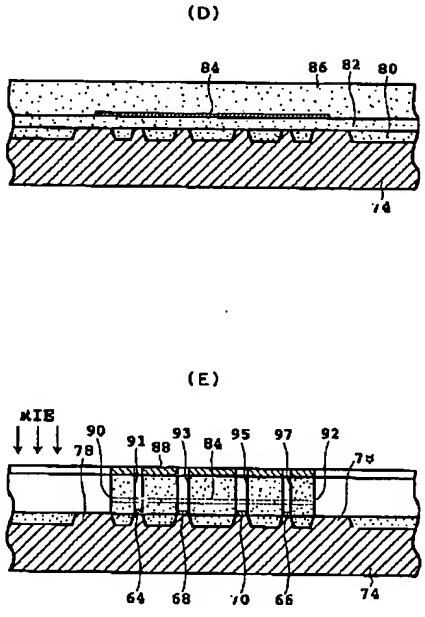
【図４】

第４実施形態



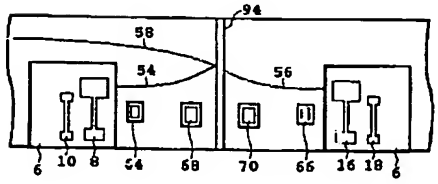
【図７】

製造プロセス図



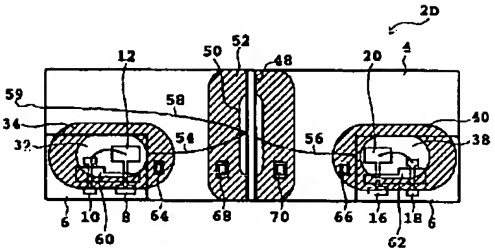
【図８】

製造プロセス図



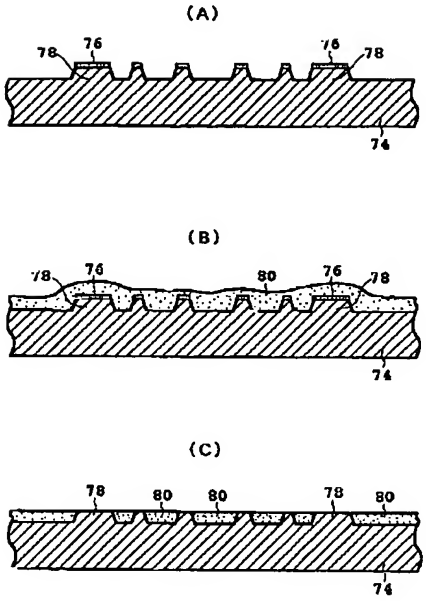
【図５】

第４実施形態平面図



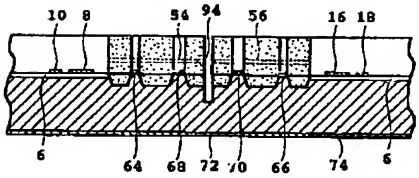
【図６】

製造プロセス図



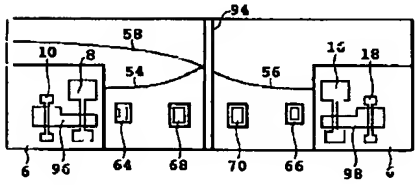
【図９】

製造プロセス図



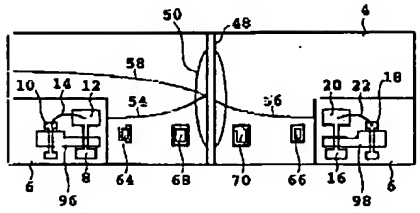
【図１０】

製造プロセス図



【図11】

製造プロセス図



フロントページの続き

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